

CLAIMS

1. A medical implant, comprising:

first and second ring members, each comprising a resilient framework having a generally cylindrical form;

5 a tubular sleeve, fixed to the first and second ring members so as to hold the ring members in mutual longitudinal alignment, thereby defining a lumen passing through the ring members; and

a constricting element, which is fit around the sleeve at a location intermediate the first and second ring members so as to reduce a diameter of the lumen at the location.

10 2. The implant according to claim 1, wherein the framework comprises a wire, which is bent in a serpentine form.

3. The implant according to claim 1, wherein the ring members are adapted to be inserted in a radially-compressed form through a body passage to a target position within the passage, and then to expand radially at the target position so as to open the lumen therethrough.

15 4. The implant according to claim 3, wherein the framework comprises an elastic material, which is compressible to provide the radially-compressed form of the ring members, and which expands radially when released at the target position.

5. The implant according to claim 1, and comprising one or more longitudinal support members, fixed to the framework of the first and second ring members, alongside the sleeve,
20 so as to join the first and second ring members together.

6. The implant according to claim 1, wherein the sleeve comprises a fabric.

7. The implant according to claim 6, wherein the fabric is stitched to the framework of the first and second ring members.

8. The implant according to claim 1, wherein the lumen passing through the first and
25 second ring members has first and second ends, and wherein the framework is configured to provide elongate protrusions at one or more of the ends of the lumen.

9. The implant according to claim 8, wherein the sleeve is cut at one or more of the first and second ends in conformance with the protrusions.

10. The implant according to claim 9, wherein the sleeve is cut at the first end in conformance with the protrusions, while the sleeve at the second end covers both the protrusions and interstices between the protrusions at the second end of the lumen.

11. The implant according to any of claims 1-10, wherein the implant is adapted to be
5 implanted in a coronary sinus of a patient, so that a flow of blood through the coronary sinus is inhibited by the reduced diameter of the lumen.

12. The implant according to any of claims 1-10, wherein the constricting element is adapted to expand under an outward radial force so as to permit the reduced diameter of the lumen to increase.

10 13. The implant according to claim 12, wherein the constricting element comprises an elastic wire, having bends that are fastened shut so as to provide the reduced diameter, and which are adapted to open under the outward radial force.

14. A method for producing a medical implant, comprising:
providing first and second ring members, each comprising a resilient framework having
15 a generally cylindrical form;

fixing a tubular sleeve to the first and second ring members so as to hold the ring members in mutual longitudinal alignment, thereby defining a lumen passing through the ring members; and

20 fitting a constricting element around the sleeve at a location intermediate the first and second ring members so as to reduce a diameter of the lumen at the location.

15. The method according to claim 14, wherein providing the framework comprises bending a wire into a serpentine form.

16. The method according to claim 15, wherein the lumen passing through the first and second ring members has first and second ends, and wherein bending the wire comprises
25 producing elongate protrusions of the framework at one or more of the ends of the lumen.

17. The method according to claim 14, and comprising fixing one or more longitudinal support members to the framework of the first and second ring members, alongside the sleeve, so as to join the first and second ring members together.

18. The method according to any of claims 14-17, wherein fixing the sleeve comprises
30 stitching a fabric to the framework of the first and second ring members.

19. The method according to any of claims 14-17, wherein fitting the constricting element comprises configuring the constricting element to expand under an outward radial force so as to permit the reduced diameter of the lumen to increase.

20. The method according to claim 19, wherein the constricting element comprises an elastic wire, having bends that are fastened shut so as to provide the reduced diameter, and which are adapted to open under the outward radial force.

21. A method for restricting flow of a fluid through a body passage, comprising:

providing an implant comprising first and second ring members, each comprising a resilient framework having a generally cylindrical form, with a tubular sleeve, fixed to the first and second ring members so as to hold the ring members in mutual longitudinal alignment, thereby defining a lumen passing through the ring members, and a constricting element fit around the sleeve at a location intermediate the first and second ring members so as to reduce a diameter of the lumen at the location;

passing the implant, in a radially-compressed form, through the body passage to a target position within the body passage; and

causing the implant to expand radially at the target position so as to open the lumen therethrough.

22. The method according to claim 21, wherein the framework comprises an elastic material, which is compressible to provide the radially-compressed form, and which expands radially when released at the target position.

23. The method according to claim 21, wherein the lumen passing through the first and second ring members has first and second ends, and wherein the framework is configured to provide elongate protrusions at one or more of the ends of the lumen, and wherein causing the implant to expand comprises anchoring the implant in the target position using the elongate protrusions.

24. The method according to claim 21, wherein the body passage is a coronary sinus of a patient, and wherein the implant inhibits a flow of blood through the coronary sinus due to the reduced diameter of the lumen.

25. The method according to any of claims 21-24, wherein passing the implant comprises enclosing the implant within a catheter, which passes through the body passage, and wherein

causing the implant to expand comprises ejecting the implant through an aperture in a distal end of the catheter.

26. The method according to claim 25, wherein the distal end of the catheter has generally conical shape, and wherein ejecting the implant comprises expanding the distal end so as to
5 open the aperture so that the implant may pass therethrough.

27. The method according to claim 25, wherein the distal end of the catheter has generally conical shape, and wherein ejecting the implant comprises tearing the distal end so as to open the aperture so that the implant may pass therethrough.

28. The method according to claim 25, wherein the distal end of the catheter comprises an
10 elastic plug, which closes the aperture while the catheter passes through the body passage, and wherein ejecting the implant comprises radially compressing the plug so as to open the aperture and to allow the lumen of the implant to pass over the plug.

29. The method according to any of claims 21-24, and comprising exerting an outward radial pressure from within the implant after the implant has expanded in the target position so
15 as to open the constricting element, thereby permitting the reduced diameter of the lumen to increase.

30. The method according to claim 29, wherein exerting the outward radial pressure comprises inserting a balloon into the lumen, and inflating the balloon.

31. Apparatus for delivery of an implant to a target position in a body passage, the
20 apparatus comprising:

an elongate, tubular sheath, which is adapted to be passed through the body passage while containing the implant in a compressed state inside the sheath, wherein the sheath has a distal end made of an elastic material in a generally conical shape with an aperture formed therein; and

25 an ejector, which is adapted to force the implant in a distal direction, thus stretching the elastic material so as to expand the aperture, whereby the implant passes through the aperture.

32. Apparatus for delivery of an implant to a target position in a body passage, the apparatus comprising:

an elongate, tubular sheath, which is adapted to be passed through the body passage while containing the implant in a compressed state inside the sheath, wherein the sheath has a distal end having a generally conical shape with an aperture formed therein; and

5 an ejector, which is adapted to force the implant in a distal direction, thus causing the distal end of the sheath to tear so as to expand the aperture, whereby the implant passes through the aperture.

33. The apparatus according to claim 32, wherein the distal end of the sheath is scored with lines, along which the sheath tears.

34. Apparatus for delivery of an implant to a target position in a body passage, the
10 apparatus comprising:

an elongate, tubular sheath, which is adapted to be passed through the body passage while containing the implant in a compressed state inside the sheath, wherein the sheath has a distal end with an aperture formed therein;

15 a lumen passing longitudinally through the sheath and through the implant contained within the sheath, such that a portion of the lumen at the distal end of the sheath is distended so as to plug the aperture while the sheath passes through the body passage, the distended portion of the lumen comprising a flexible material; and

20 an ejector, which is adapted to force the implant in a distal direction, thus ejecting the implant through the aperture and compressing the distended portion of the lumen, so that the implant passes over the lumen to the target position in the body passage.

35. Apparatus for narrowing a body passage, the apparatus comprising:
a narrowing implant, which comprises:

first and second ring members, each comprising a resilient framework having a generally cylindrical form;

25 a tubular sleeve, fixed to the first and second ring members so as to hold the ring members in mutual longitudinal alignment, thereby defining a lumen passing through the ring members; and

30 a constricting element, which is fit around the sleeve at a location intermediate the first and second ring members so as to reduce a diameter of the lumen at the location; and

a catheter for delivering the implant to a target position in the body passage.

36. The apparatus according to claim 35, wherein the catheter comprises:

an elongate, tubular sheath, which is adapted to be passed through the body passage while containing the implant in a compressed state inside the sheath, wherein the sheath has a distal end having a generally conical shape with an aperture formed therein; and

5 an ejector, which is adapted to force the implant in a distal direction, thus stretching the elastic material so as to expand the aperture, whereby the implant passes through the aperture and is implanted at the target position.

37. The apparatus according to claim 35, wherein the catheter comprises:

10 an elongate, tubular sheath, which is adapted to be passed through the body passage while containing the implant in a compressed state inside the sheath, wherein the sheath has a distal end having a generally conical shape with an aperture formed therein; and

an ejector, which is adapted to force the implant in a distal direction, thus causing the distal end of the sheath to tear so as to expand the aperture, whereby the implant passes through the aperture and is implanted at the target position.

15 38. The apparatus according to claim 35, wherein the catheter comprises:

an elongate, tubular sheath, which is adapted to be passed through the body passage while containing the implant in a compressed state inside the sheath, wherein the sheath has a distal end with an aperture formed therein;

20 a lumen passing longitudinally through the sheath and through the implant contained within the sheath, such that a portion of the lumen at the distal end of the sheath is distended so as to plug the aperture while the sheath passes through the body passage, the distended portion of the lumen comprising a flexible material; and

25 an ejector, which is adapted to force the implant in a distal direction, thus ejecting the implant through the aperture and compressing the distended portion of the lumen, so that the implant passes over the lumen to the target position in the body passage.

39. A stent for implantation in a lumen, comprising:

a plurality of struts, with intervening openings therebetween; and

narrow connecting pieces, bridging at least some of the openings so as to interconnect the struts,

30 wherein exertion of a first outward radial force on the struts causes the stent to open to a first diameter by opening the intervening openings between the struts, and

wherein the narrow connecting pieces are adapted to break under exertion on the struts of a second outward radial force, greater than the first outward radial force, so that the stent opens to a second diameter, greater than the first diameter.

40. A method for narrowing a blood vessel, comprising:

- 5 inserting a catheter into the blood vessel;
- deploying a clip outward from the catheter so that first and second ends of the clip engage respective first and second points on a wall of the blood vessel; and
- ejecting the clip from the catheter after the first and second ends of the clip have engaged the first and second points, thus causing the ends of the clip to draw toward one
- 10 another and thereby pinching together the first and second points.